

What is Claimed:

1           1. A method of charging a battery having an internal  
2 resistance and an external resistance connected to the battery comprising the  
3 steps of:

4                 applying electrical energy to the battery; and

5                 adjusting, at each of a plurality of predetermined intervals, the  
6 electrical energy applied to the battery based on at least one of the internal  
7 resistance of the battery and the external resistance connected to the  
8 battery.

1           2. The method of claim 1 comprising the additional step of:

2                 determining at least one of (a) the internal resistance of the  
3 battery, and (b) the external resistance connected to the battery.

1           3. The method of claim 1 comprising the additional step of:

2                 determining a voltage drop associated with at least one of (a)  
3 the internal resistance of the battery, and (b) the external resistance  
4 connected to the battery.

1           4. The method of claim 3 wherein the determining step  
2 occurs when the battery is substantially neither charging nor discharging.

1           5. The method of claim 3 comprising the additional steps of:

2                 (a) applying the electrical energy to the battery for a  
3 predetermined charging time period;

4                 (b) applying a discharge pulse to the battery for a  
5 predetermined discharging time period;

6                             (c) providing a predetermined rest period during which neither  
7                             the electrical energy nor the discharge pulse is applied to the battery, and  
8                             during which the determining step takes place; and

9                             (d) repeating steps (a), (b), and (c).

1                         6.     The method of claim 3 wherein a protective device is  
2                             connected to the battery and the determining step includes determining a  
3                             voltage drop across the protective device.

1                         7.     The method of claim 3 wherein the battery is comprised of  
2                             at least one of a terminal resistance and a lead resistance and the  
3                             determining step includes determining a voltage drop across at least one of  
4                             the terminal resistance and the lead resistance.

1                         8.     The method of claim 1 having a charging period and a  
2                             non-charging period comprising the additional steps of:

3                             (a) measuring the voltage of the battery during the non-  
4                             charging period; and

5                             (b) measuring the voltage of the battery during the charging  
6                             period,

7                             the electrical energy being adjusted during the adjusting step  
8                             based on a difference between the voltage measured during step (a) and the  
9                             voltage measured during step (b).

1                         9.     The method of claim 1 having a charging period and a  
2                             non-charging period comprising the additional steps of:

3                             (a) determining if the battery voltage during the non-charging  
4                             period is greater than or equal to a predetermined threshold voltage level;  
5                             and

6                             (b) terminating a constant current portion of a charging cycle if  
7     the battery voltage during the non-charging period is greater than or equal to  
8     the threshold voltage level.

1                 10. The method of claim 1 comprising the additional steps of:

2                             (a) determining if a charging current being applied to the battery  
3     is greater than a predetermined current level during a constant current phase  
4     of a charging cycle of the battery;

5                             (b) decreasing the charging current if it is determined to be  
6     above the predetermined current level; and

7                             (c) increasing the charging current if it is determined to be below  
8     the predetermined current level.

1                 11. The method of claim 1 comprising the additional steps of:

2                             (a) determining if a charging current being applied to the battery  
3     is below a predetermined current level during a constant voltage phase of a  
4     charging cycle of the battery; and

5                             (b) terminating the constant voltage phase of the charging cycle  
6     if the charging current being applied to the battery is below the  
7     predetermined current level.

1                 12. The method of claim 1 wherein the adjusting step includes  
2     adjusting the duration of a pulse of the electrical energy applied to the  
3     battery.

1                 13. A computer readable carrier including computer program  
2     instructions for implementing a method of charging a battery having an  
3     internal resistance and an external resistance connected to the battery, the  
4     method comprising the steps of:

5                         applying electrical energy to the battery; and  
6                         adjusting, at each of a plurality of predetermined intervals, the  
7                         electrical energy applied to the battery based on at least one of the internal  
8                         resistance of the battery and the external resistance connected to the  
9                         battery.

1                         14. The computer reader carrier of claim 13 wherein the  
2                         method comprises the additional step of determining a voltage drop  
3                         associated with at least one of (a) the internal resistance of the battery, and  
4                         (b) the external resistance connected to the battery.

1                         15. The computer reader carrier of claim 14 wherein the  
2                         method comprises the additional steps of:

3                         (a) applying the electrical energy to the battery for a  
4                         predetermined charging time period;  
5                         (b) applying a discharge pulse to the battery for a  
6                         predetermined discharging time period;  
7                         (c) providing a predetermined rest period during which neither  
8                         the electrical energy nor the discharge pulse is applied to the battery, and  
9                         during which the determining step takes place; and

10                         (d) repeating steps (a), (b), and (c).

1                         16. The computer reader carrier of claim 13 wherein the  
2                         method comprises the additional steps of:

3                         (a) measuring the voltage of the battery during a non-charging  
4                         period; and  
5                         (b) measuring the voltage of the battery during a charging  
6                         period,

7                   the electrical energy being adjusted during the adjusting step  
8   based on a difference between the voltage measured during step (a) and the  
9   voltage measured during step (b).

1                 17. An electronic device comprising:

2                   a battery having an internal resistance and an external  
3   resistance connected to the battery; and

4                   a computer readable carrier including computer program  
5   instructions for implementing a method of charging the battery, the method  
6   comprising the steps of:

7                   applying electrical energy to the battery; and

8                   adjusting, at each of a plurality of predetermined intervals, the  
9   electrical energy applied to the battery based on at least one of the internal  
10   resistance of the battery and the external resistance connected to the  
11   battery.

1                 18. The electronic device of claim 17 wherein the method  
2   comprises the additional step of determining a voltage drop associated with  
3   at least one of (a) the internal resistance of the battery, and (b) the external  
4   resistance connected to the battery.

1                 19. The electronic device of claim 18 wherein the method  
2   comprises the additional steps of:

3                   (a) applying the electrical energy to the battery for a  
4   predetermined charging time period;

5                   (b) applying a discharge pulse to the battery for a  
6   predetermined discharging time period;

7 (c) providing a predetermined rest period during which neither  
8 the electrical energy nor the discharge pulse is applied to the battery, and  
9 during which the determining step takes place; and

(d) repeating steps (a), (b), and (c).

1                   20. The electronic device of claim 17 wherein the method  
2 comprises the additional steps of:

3 (a) measuring the voltage of the battery during a non-charging  
4 period; and

(b) measuring the voltage of the battery during a charging period,

the electrical energy being adjusted during the adjusting step based on a difference between the voltage measured during step (a) and the voltage measured during step (b).

1 21. An electronic device comprising:

4 a processor, the processor controlling an electrical energy source  
5 for applying electrical energy to the battery, and

the processor adjusting, after each of a plurality of predetermined intervals, the electrical energy applied to the battery based on at least one of the internal resistance of the battery and the external resistance connected to the battery.

1                   22. The electronic device of claim 21 wherein the method  
2 comprises the additional step of determining a voltage drop associated with

3 at least one of (a) the internal resistance of the battery, and (b) the external  
4 resistance connected to the battery.

1 23. The electronic device of claim 22 wherein the method  
2 comprises the additional steps of:

3 (a) applying the electrical energy to the battery for a  
4 predetermined charging time period;

5 (b) applying a discharge pulse to the battery for a  
6 predetermined discharging time period;

7 (c) providing a predetermined rest period during which neither  
8 the electrical energy nor the discharge pulse is applied to the battery, and  
9 during which the determining step takes place; and

10 (d) repeating steps (a), (b), and (c).

1 24. The electronic device of claim 21 wherein the method  
2 comprises the additional steps of:

3 (a) measuring the voltage of the battery during a non-charging  
4 period; and

5 (b) measuring the voltage of the battery during a charging  
6 period,

7 the electrical energy being adjusted during the adjusting step  
8 based on a difference between the voltage measured during step (a) and the  
9 voltage measured during step (b).